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THE CODORUS CREEK WASTEWATER MANAGEMENT STUDY. APPENDIX A. TECH--ETC(U)
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THE
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WASTEWATER MANAGEMENT STUDY

16
AUGUST 1972

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APPENDIX A - TECHNICAL STUDIES - VOLUME II

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INTRODUCTION

↙ This report is the second in a series of four reports that encompass the Codorus Creek Wastewater Management Study. It takes off from the first report which inventoried present systems and water quality conditions. The purpose of this second report is to identify and evaluate future water resource - wastewater management needs based on assessments of future area growth and environmental management objectives. ↘

DEMOGRAPHIC AND ECONOMIC GROWTH TRENDS

Population Growth

Demands made by future populations form the basis for planning future wastewater system capacities. In this study, population forecasts were made through the year 2020 for each of the subareas and population concentrations in the Codorus Basin. A two step approach was used, employing two different sources of information.

The overall growth in York County was based on forecasts developed by the Office of Business Economics (OBE) for the Northeastern United States and disaggregated to the county level for the U. S. Army Corps of Engineers Northeast Water Study (NEWS). Three different forecasts are available from OBE-NEWS, as follows:

- (A) Concentrated Development - assumes the central city will continue to grow and increase in density. Future suburban densities will be in the range of present day high suburban density.
- (B) Dispersed Development - assumes the future will yield more single-family suburban development which will be of low density and will involve considerable distance commuting to the central city.
- (C) Most Likely Development - assumes future suburbanization around central cities with suburban densities similar to those of the 1960's; with stagnation or decline in central city population.

Population forecast "C. Most Likely Development" was selected for use in the present study because it best represents the York County Planning Commission (YCPC) projection of distribution of future populations; namely, a stabilization of central city population with major growth within the nearby suburban townships.

The present intra-county population distribution and the relative growth through 2020 of the various subareas vis-a-vis each other was developed from projections in the 1969 York County Planning Commission Comprehensive Sewage Study. In some cases the 1969 projections of 1970 population did not agree with the 1970 Census and adjustments

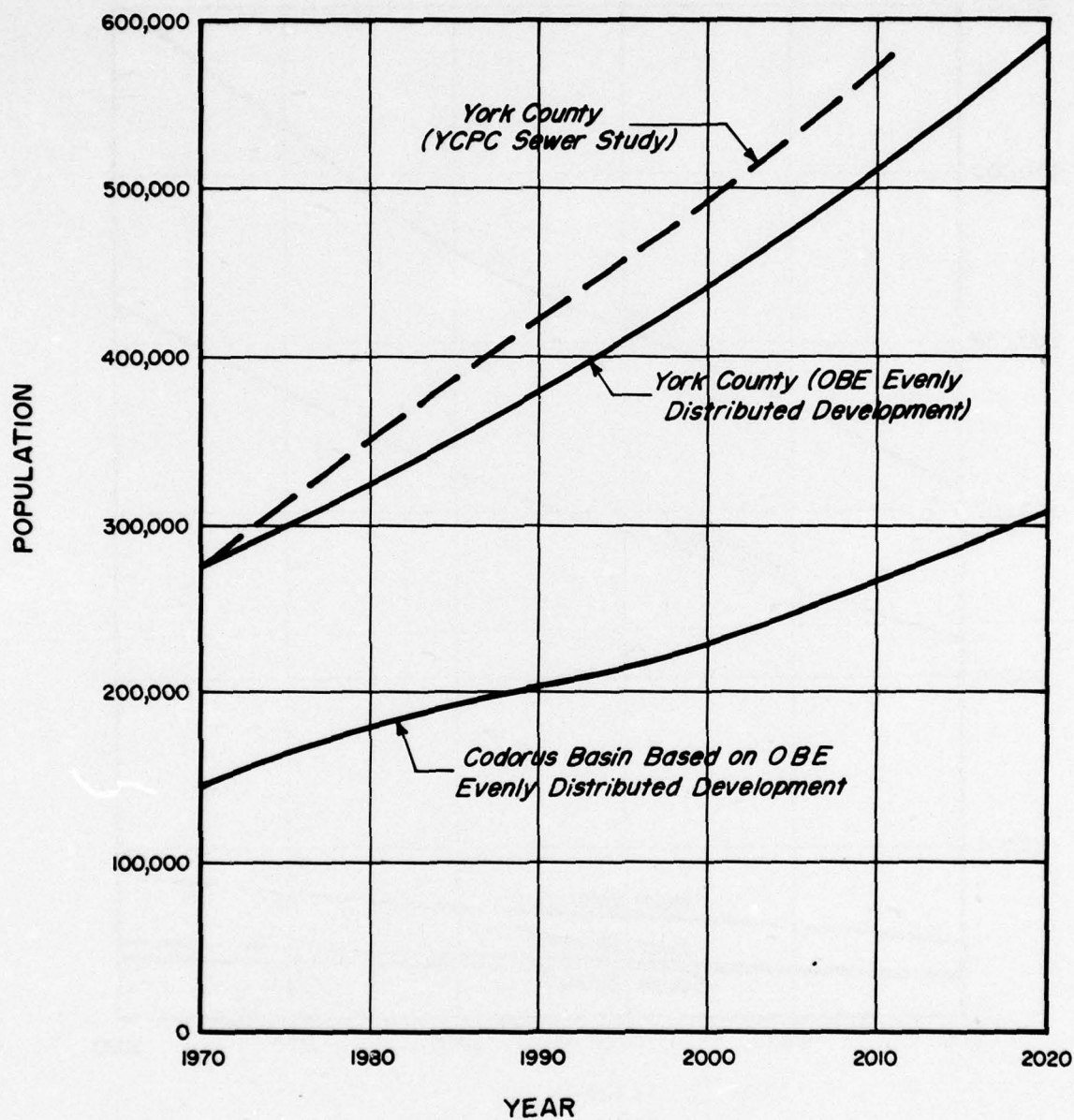
were made to the projections. The result was a Census-adjusted population projection based on YCPC growth rates.

The YCPC Comprehensive Sewage Study and OBE-NEWS forecasts are shown on Exhibit II-1 together with the derived forecast for the Codorus Basin. The YCPC forecast is higher than the OBE-NEWS forecast. This difference could be attributed to any number of causes; however, one must note that the local (YCPC) forecast may have a built-in "booster effect" while the OBE-NEWS forecast is more likely to account for regional economic completion within the Commonwealth of Pennsylvania and the Northeast in general. All forecasts show considerable growth in coming years with almost double the 1970 population occurring in the year 2020.

Sub-Basin Forecasts - For the period 1970-2020, the population growth for each of the four sub-basins, that is the Main Stem, West Branch, South Branch and East Branch, is shown in Exhibit II-2. As shown in the exhibit, most of the population and growth will take place in the Main Stem in which the Greater York Area is located. Only about 30% of the basin population growth will occur elsewhere in the West, South, or East Branch basins. In the total basin, population will approximately double from a 1970 level of about 155,000 to a year 2020 level of over 300,000.

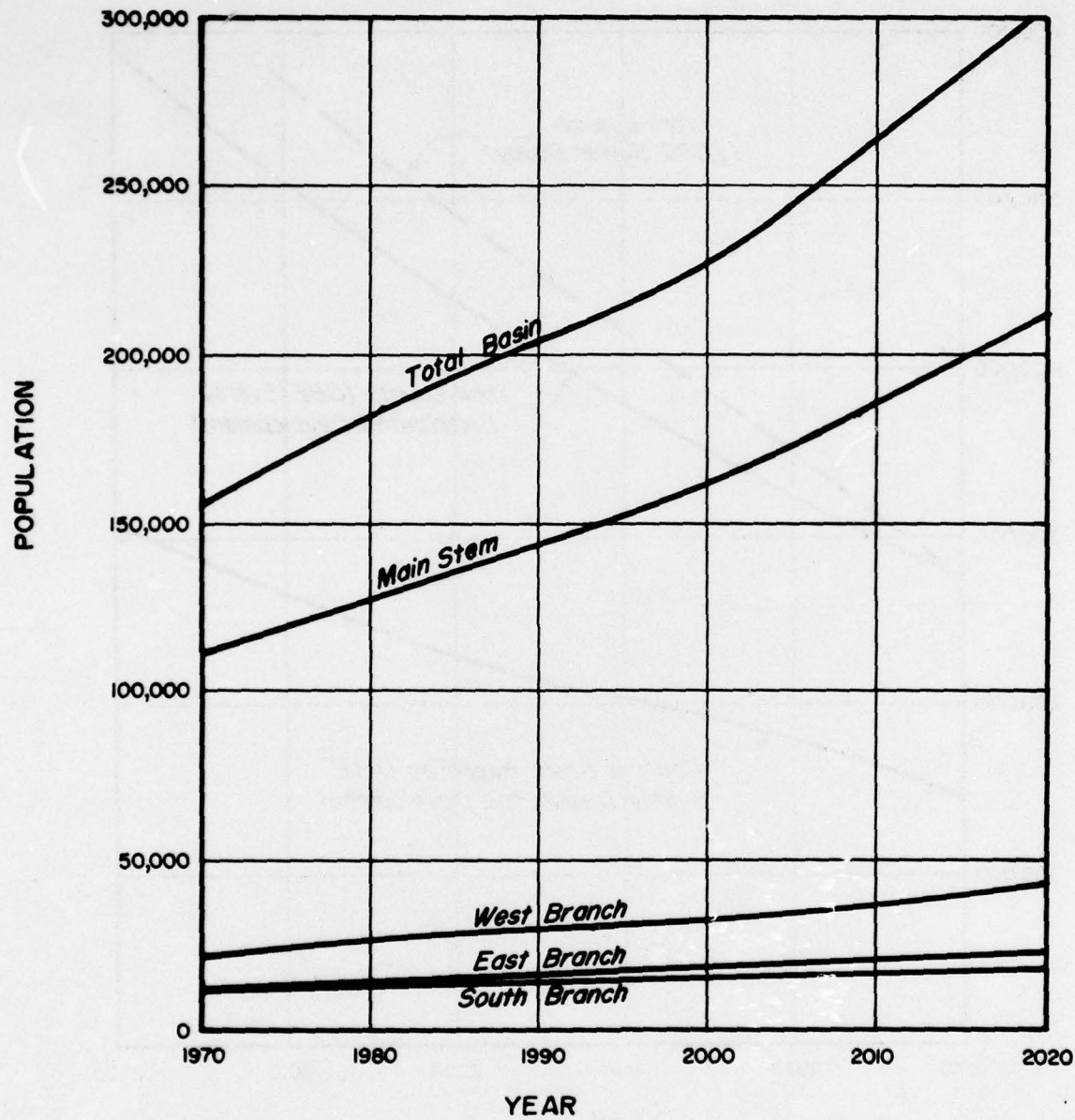
Urban Node Population - As discussed in the Vol. I report, the urban nodes are: Greater York (City of York and suburbs), Red Lion-Dallastown-Yoe, Hanover-Penn Township, Shrewsbury-New Freedom-Railroad, Spring Grove and Glen Rock. The population growth for these areas is shown in Exhibit II-3. The Greater York Area far surpasses the other urban nodes in population growth with a significant amount of that growth (shown as a dashed line in Exhibit II-3) taking place in suburban townships lying outside the Codorus Basin.

The location of the urban nodes are shown in Exhibit II-4 along with the projected limits of urban development in 1970 and 2000. The 1970 limits are taken from the YCPC Sewage Study and other available information. The 2000 limits are from the York County Planning Commission Land Use forecasts for that year. It must be noted that the YCPC land use forecasts allow for a surplus of land over and above that needed to house its forecasted population; in short, the land use forecast reflects the realities of choice and degrees of freedom in future population location decisions. As shown in Exhibit II-4, development trends are such that major growth will radiate out from the York urban core east along U.S. 30 toward Hallam Borough, north along I-83, and northwest to Dover



YORK COUNTY POPULATION FORECASTS

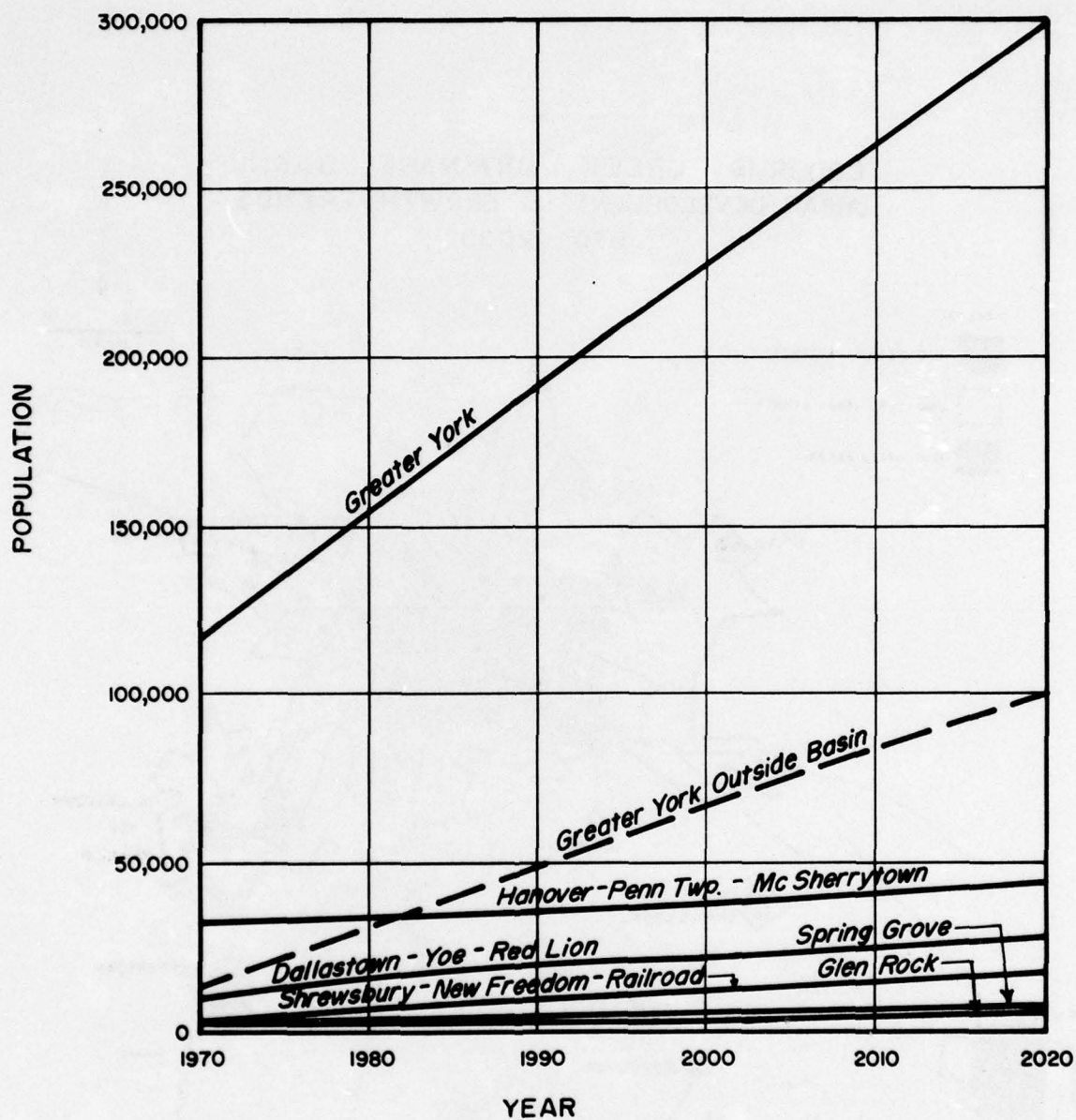
1970 - 2020



^a. Based on OBE - NEWS County projections distributed according to YCPC projections.

BASIN POPULATION GROWTH BY SUB-BASINS^a

1970 - 2020



a. Includes both portions within and outside Codorus Basin except as noted.

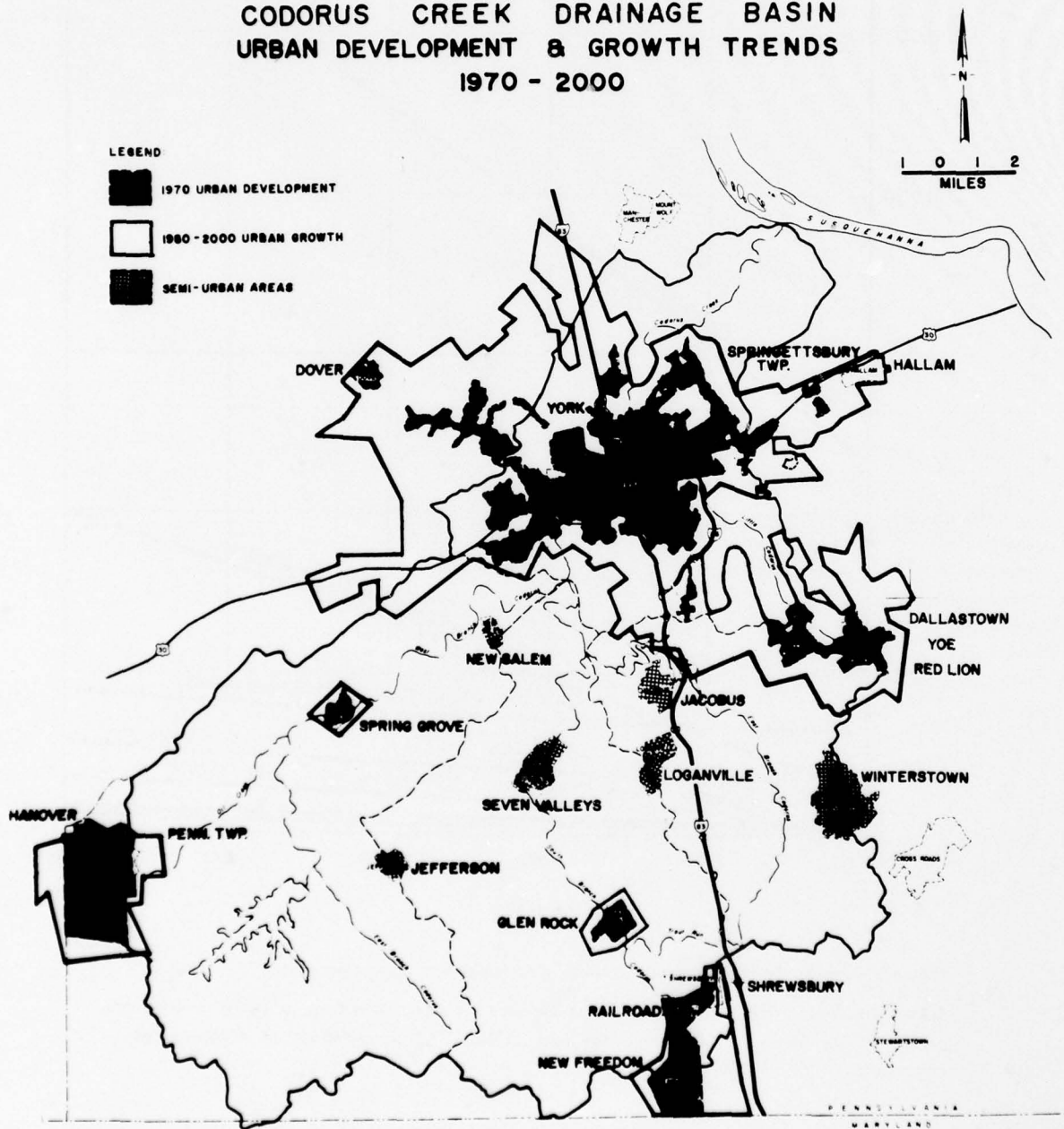
b. Based on OBE-NEWS County projections distributed according to YCPC projections except in the case of 2020 where the year 2000 YCPC distribution is extrapolated according to OBE-NEWS 2020 forecasts.

POPULATION URBAN NODES^{a, b}

1970 - 2020

EXHIBIT II-4

CODORUS CREEK DRAINAGE BASIN
URBAN DEVELOPMENT & GROWTH TRENDS
1970 - 2000



Township and Dover Borough. Lesser growth rates are shown for the other urban nodes within the basin.

Semi-Urban Population - The semi-urban outlying towns are Jacobus, Loganville, New Salem, Seven Valleys, Jefferson, and Wintertown Boroughs. Taken together, these outlying towns account for 2.6 percent of the 1970 basin population. Those with the largest growth are expected to be Jacobus Borough (in close proximity to the Greater York Urban Node), Loganville Borough, and New Salem Borough. Although Exhibit II-4 does not show limits of urbanization, it can be assumed that some portion of growth in these outlying communities will occur outside the community boundaries; this is particularly true for Jacobus, Loganville and New Salem Boroughs.

Rural Population - The remaining population growth, that which is not contained within an urban node or a semi-urban outlying community, is assumed to be rural population and is distributed throughout the non-urban portions of the basin. Total rural population is estimated to be about 25,000 in 1970, and is expected to remain approximately that amount over the fifty year period of forecast.

Population Summary - Population projections for the years 1980, 2000, and 2020 are given in Exhibit II-5 in the same manner as was done in Vol. I in regard to 1970 population. Tabulations are presented for the urban nodes, the semi-urban areas, and the rural areas. Of particular importance is that the urban node population outside the basin will become an increasing part of total urban node population with the passing of time.

Economic Activity Projections

The economic activity composition of the Codorus Creek Study Area can be expected to reflect general trends observed in most urbanizing and central city areas. These generalized trends include: a sustained economic growth in the metropolitan area which is lower, proportionately, than that of the overall region; a tendency in the region to approach the distribution characteristics of the metropolitan area; and a tendency for the metropolitan area to diversify its economic makeup.

The data presented in this section is fragmentary, its major value being that of providing scattered insights into the economic future of the study area. The majority of projections made by County and City agencies are simple extrapolations of observed trends, tempered by some

Exhibit II-5
**CODORUS CREEK STUDY AREA
 POPULATION PROJECTIONS**

<u>Urban Node</u>	<u>1980 Population Projections</u>		
	<u>Population in Study Area</u>	<u>Population in Codorus Basin</u>	<u>Population outside Codorus Basin</u>
Greater York	155,118	124,184	30,934
Hanover-Penn Township	32,500 ^a	10,590	21,910 ^a
Shrewsbury-New Freedom- Railroad	6,503	4,947	1,556
Glen Rock	2,136	2,136	0
Spring Grove	3,065	3,065	0
Red Lion-Dallastown-Yoe	15,542	13,586	1,956
<u>Semi-Urban Area</u>			
Jefferson Borough	511	511	0
Seven Valleys Borough	743	743	0
Loganville Borough	1,207	1,207	0
Jacobus Borough	2,023	2,023	0
New Salem Borough	1,486	1,486	0
Winterstown Borough	400	202	198
<u>Rural Area</u>			
Main Stem Sub-Basin	835	835	0
West Branch Sub-Basin	11,097	11,097	0
South Branch Sub-Basin	4,469	4,469	0
East Branch Sub-Basin	<u>2,795</u>	<u>2,795</u>	<u>0</u>
Total	240,430	183,876	56,554

^aTotal including Hanover Urban Area outside York County.

Exhibit II-5
(Cont.)

2000 Population Projections			2020 Population Projections		
Population in Study Area	Population in Codorus Basin	Population Outside Codorus Basin	Population in Study Area	Population in Codorus Basin	Population Outside Codorus Basin
227,032	157,982	69,050	300,000 ^a	200,000	100,000
40,400 ^a	13,118	27,282 ^a	50,000 ^a	20,000	30,000 ^a
6,989	5,518	1,471	20,000	11,500	8,500
2,925	2,925	0	7,500	7,500	0
3,368	3,368	0	7,500	7,500	0
20,419	13,858	6,561	30,000	16,500	13,500
545	545	0	575	575	0
886	886	0	900	900	0
2,092	2,092	0	2,400	2,400	0
3,036	3,036	0	3,700	3,700	0
1,653	1,653	0	1,625	1,625	0
399	202	197	400	202	198
1,034	1,034	0	1,000	1,000	0
13,411	13,411	0	14,750	14,750	0
5,885	5,885	0	4,300	4,300	0
2,792	2,792	0	2,500	2,500	0
332,866	228,305	104,561	447,150	294,952	152,198

gross policy assumptions. In most instances, this report accepts the aforementioned projections and extends or scales them only to reflect a higher total population and a longer projection period.

The following Exhibit, "York Metropolitan Area Labor Force," is derived, in part, from the York Area Transportation Study (YATS) April 1971 report¹. The study area includes both the area designated as Greater York in the preceding population projections and Red Lion, Dallastown and Yoe.

EXHIBIT II-6

YORK METROPOLITAN AREA LABOR FORCE*

	<u>1964</u>	<u>1970</u>	<u>1980</u>	<u>1990</u>	<u>2000</u>	<u>2020</u>
Population	122,075	127,675	167,130	201,285	247,450	330,000
Employment Opportunities in Metropol- itan Area York	58,885	63,470	73,700	85,000	97,500	130,000
Labor Force	48,250	49,785	63,980	77,095	94,030	124,740
Participation Rate	39.5	39.0	38.5	38.3	38.0	37.8

* Including Red Lion-Dallastown-Yoe

YATS projected population has been adjusted to be consistent with population forecasts of this report. Employment opportunities have been scaled upward in proportion to the higher population growth projections used in this study.

The participation rate, that is the percentage of the total population which is actively employed or seeking employment, has been retained from the YATS report. This rate, times the adjusted population, results in the adjusted labor force numbers.

¹York Area Transportation Study, Analyses and Forecasts, Volume II, April 1967.

Exhibit II-6 indicates that employment opportunities within the York Metropolitan Area will continue to exceed the resident labor force. This reflects an expected continuation of new employment concentration in the York Metropolitan Area. This stems, partially, from assumed regional policy decisions to maintain a sustained growth of the metropolitan area employment opportunities. It assumes a continued, although diminishing, participation of a non-metropolitan area labor force in the metropolitan area.

Several major assumptions have been made in this report regarding the labor force outside the York Metropolitan Area. These include:

1. The entire labor force of the Codorus Creek Study Area (the basin plus associated urban population nodes outside the basin) is assumed to be employed within the Study Area. This can be assumed because the study area largely describes an employment service region, the remaining County population being employed either in Harrisburg or within the small outlying towns.
2. The employment opportunities outside the York Metropolitan Area are assumed to grow at a rate which will supply employment to the study area labor force which is not employed within the York Metropolitan Area.
3. Full employment is assumed.
4. As a matter of County policy, employment opportunities outside the York Metropolitan Area are located in major urban nodes rather than being uniformly distributed throughout the Study Area.

The following table, "Codorus Creek Study Area Labor Force", shows population, labor force, participation rates and employment opportunities in the York Metropolitan Area and the remainder of the Study Area.

EXHIBIT II-7

CODORUS CREEK STUDY AREA LABOR FORCE*

	<u>1960</u>	<u>1970</u>	<u>1980</u>	<u>2000</u>	<u>2020</u>
Population	167,555	188,580	240,232	336,196	457,000
Labor Force	67,020	73,515	92,490	127,755	162,750
Participation Rate	40.0	39.0	38.5	38.0	37.8
Employment Opportunities in York Metropolitan Area	57,500	63,470	73,700	97,500	130,000
Employment Opportunities Outside York Metropolitan Area	9,520	10,045	18,790	30,255	32,750

* Includes the basin area population plus associated population outside the basin.

Employment projections by economic sector - agriculture-mining (primary), manufacturing (secondary), and service-wholesale-retail and related (tertiary) - have been developed for the Study Area, the York Metropolitan Area, and the Study Area outside the York Metropolitan Area (Exhibit II-8). These are developed through the year 2020.

These projections are distribution and extrapolations of employment estimates prepared by the York County Planning Commission¹ for York County and by YATS for the York Metropolitan Area², and are basically trends projections. They have been extrapolated in this report from the year 1990 to 2020 on a straight line basis.

¹YCPC, Economic Analyses.

²YATS, Analyses and Forecasts, Volume II, April 1971.

EXHIBIT II-8

EMPLOYMENT PROJECTIONS

Sector Employment in Codorus Creek Study Area

	1960	1970	1980	2000	2020
Primary	(2) 1,340	(2) 1,470	(2) 1,850	(2) 2,555	(2) 3,250
Secondary	(60) 40,215	(59.5) 43,740	(57.5) 53,180	(53) 67,610	(49) 79,750
Tertiary	(38) 25,465	(38.5) 28,305	(40.5) 37,460	(45) 57,590	(49) 79,750
Total Employment					
Opportunities	67,020	73,515	92,490	127,755	162,750

Sector Employment in the York Metropolitan Area

	1960	1970	1980	2000	2020
Primary	(0) 0	(0) 0	(0) 0	(0) 0	(0) 0
Secondary	(68) 39,100	(66) 41,890	(63) 48,950	(58) 56,350	(53) 68,900
Tertiary	(32) 18,400	(34) 21,580	(37) 24,750	(42) 41,150	(47) 61,100
Total Employment					
Opportunities	57,500	63,470	73,700	97,500	130,000

Sector Employment in the Study Area Outside the York Metropolitan Area

	1960	1970	1980	2000	2020
Primary	1,340	1,470	1,850	2,555	3,250
Secondary	1,115	1,850	4,230	11,260	10,850
Tertiary	7,065	6,725	12,710	16,410	18,650
Total Employment					
Opportunities	9,520	10,045	18,790	30,255	32,750

Note: Numbers in parenthesis are the percent of the total.

Based on the projections presented one can establish the following general trends in employment growth in the Study Area. They are:

1. Manufacturing, as a percentage of entire employment, is declining for all three areas. However, the actual number of jobs in this sector remains on the increase because of the population growth.
2. The agriculture and mining sector will remain stable at two percent of the York County and Study Area employment. The percentage of agricultural and mining jobs in the York Metropolitan Area is insignificant.
3. The tertiary sector (service, wholesale-retail, and related jobs) is increasing in all areas and will constitute the largest sector by the year 2020.

The manufacturing sector, although decreasing proportionately, is increasing in actual job opportunities in both the York Metropolitan Area and the outlying urban nodes. This sector, itself, is composed of many industry types which vary in growth potential. The types of industry which will grow faster than average include: furniture and fixtures, paper and allied products, printing and publishing, rubber and plastics, machinery and electrical equipment and transportation equipment. These industries, in general, offer a higher wage and employ a substantial portion (almost half) of the total County labor force.

Within the tertiary sector, service employment is increasing at the fastest rate, both for the entire Study Area and the York Metropolitan Area. Wholesale and retail employment is also expanding at a rapid rate. The net effect of the employment projections for the Codorus Creek Study Area and the York Metropolitan Area is the progression toward a more fully diversified economy from its present primarily manufacturing base.

WASTEWATER FLOW PROJECTIONS

Domestic Wastewater Flow Projections

Increases in the present domestic wastewater flows presented in Phase I are a function of the following three factors: 1) population increases; 2) increases in per capita water usage; and 3) increases in the extent of the sewered areas. The population projections presented earlier

in this report are the basis of the projected wastewater flows presented in Exhibit II-9. The York Water Company has experienced, over the past 30 years, an average growth in per capita water consumption of 8 gpcd per decade, as shown on Exhibit II-10. It was assumed that this trend will continue and that the per capita wastewater flows will increase at an equal rate. This assumption is consistent with local historical trends and leads to projections which are reasonable and consistent with other areas in the country which have population and economic activity patterns similar to York.

The projected service areas for wastewater treatment are shown on Exhibit II-11 and will be discussed in the following paragraphs. It should be noted that the York Urban Node has been subdivided into the York, Springettsbury and Dover service areas. The Dover service area was defined as that portion of the York Urban Node within Dover Township including Dover Borough. Flow projections are based on the assumption that 90 percent of the service area population would be sewer-ed by 1980 and that 100 percent would be sewer-ed by 2000.

Red Lion-Dallastown-Yoe - Although the Red Lion-Dallastown-Yoe Service Area presently has its own treatment facilities, the Mill Creek interceptor, now under design, will bring this wastewater to Springettsbury and the Red Lion plant will be abandoned. Projections for the Red Lion-Dallastown-Yoe area recognized the fact that the present domestic per capita wastewater flow to the treatment plant (46 gpcd based on a domestic flow of 0.25 MGD, see Exhibit I-11) experienced by the Borough of Red Lion is too low to realistically project future flows due to the high sewer charges now in existence. The total domestic wastewater flow should be more in line with the Red Lion Water Company pumpage and was computed to be approximately 0.74 MGD in 1970. The per capita domestic wastewater generation for this flow is some 65 gpcd which is the basis of the projections in this study.

Hanover-Penn Township - About one-half of the Hanover-Penn Service Area is outside of the Codorus Basin. The present Hanover sewage treatment plant discharges to the Conewego Basin and the Penn Township plant discharges to Oil Creek (a tributary of the West Branch of Codorus Creek). The wastewater flow projections in Exhibit II-10 include the total service area.

New Freedom-Tri-borough - The New Freedom-tri-borough Area in 1970 was not sewer-ed. However, an analysis of their water consumption data indicated that in 1970 the industrial-commercial water consumption for this area was approximately 0.25 MGD. The domestic consumption for New Freedom and Shrewsbury was 69 gpcd. It was

EXHIBIT II-9
SEWAGE TREATMENT PLANT
DOMESTIC WASTEWATER FLOW PROJECTIONS

<u>Service Area</u>	<u>Year</u>	<u>Total Population In Urban Area</u>	<u>Population Connected (%)</u>	<u>Per Capita Domestic Flow (gpcd)</u>	<u>Sewage Treatment Plant Domestic Wastewater Flow Projections (MGD)</u>
<u>York Urban Node</u>					
York Service Area	1970 ¹	117,000	69	111	9.0
	1980	119,000	90	119	12.7
	2000	169,000	100	135	22.8
	2020	205,000	100	151	31.0
<u>Springettsbury service Area</u>	1970 ²				-
	1980	26,800	90	119	2.9
	2000	40,000	100	135	5.4
	2020	67,000	100	151	10.1
<u>Dover Service Area</u>	1970	1,200	100	100	0.12
	1980	9,300	90 ³	108	0.9
	2000	18,000	100	124	2.2
	2020	28,000	100	140	3.9
<u>Hanover-Penn Twp Urban Node</u>					
Penn Twp. Service Area	1970	7,000	90	86	0.5
	1980	9,000	90	94	0.8
	2000	13,000	100	110	1.4
	2020	18,000	100	126	2.3
<u>Hanover Borough Service Area</u>	1970	21,800	76	100	1.7
	1980	23,500	90	108	2.3
	2000	27,000	100	124	3.3
	2020	32,000	100	140	4.5
<u>Red Lion-Dallastown-Yoe Urban Node</u>					
Red Lion-Dallastown-Yoe Service Area	1970	10,000	56	46	0.25
	1980	15,500	90	73	1.0
	2000	20,400	100	89	1.8
	2020	30,000	100	105	3.2
<u>Shrewsbury-New Freedom-Railroad Urban Node</u>					
Shrewsbury-New Freedom- Railroad Service Area	1970	3,500	0	-	-
	1980	6,500	90	80	0.5
	2000	12,000	100	96	1.1
	2020	20,000	100	112	2.2

Exhibit II-9 (Cont.)

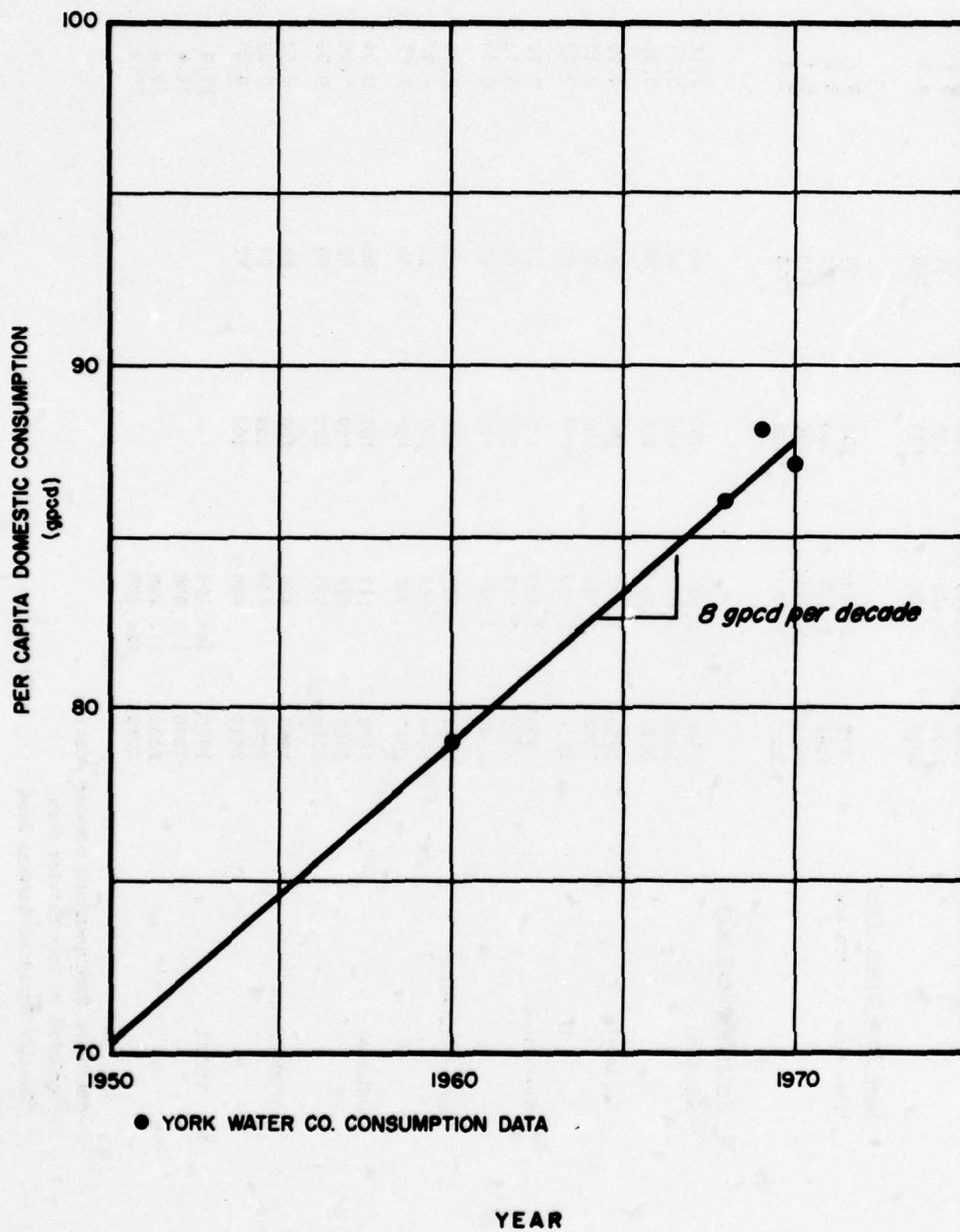
<u>Spring Grove Urban Node</u>						
Spring Grove Service Area						
1970	1,700	100	60	0.1		
1980	3,100	100	68	0.2		
2000	3,400	100	84	0.3		
2020	7,500	100	100	0.8		
<u>Glen Rock Urban Node</u>						
Glen Rock Service Area						
1970	1,600	100	95	0.2		
1980	2,100	100	103	0.2		
2000	3,000	100	119	0.4		
2020	7,500	100	135	1.0		
<u>Semi-Urbanized Area</u>						
Jacobus						
1980	2,023	100	80	0.16		
2000	3,036	100	80	0.24		
2020	3,700	100	80	0.30		
Loganville						
1980	1,207	100	80	0.10		
2000	2,092	100	80	0.17		
2020	2,400	100	80	0.19		
New Salem						
1980	1,486	100	80	0.12		
2000	1,653	100	80	0.13		
2020	1,625	100	80	0.13		
Seven Valleys						
1980	743	100	80	0.06		
2000	886	100	80	0.07		
2020	900	100	80	0.07		
Jefferson						
1980	511	100	80	0.04		
2000	545	100	80	0.04		
2020	575	100	80	0.05		
Winterstown						
1980	400	100	80	0.03		
2000	400	100	80	0.03		
2020	400	100	80	0.03		
TOTAL						
1970	165,200			11.9		
1980	221,000			22.8		
2000	314,400			39.4		
2020	424,600			59.8		

¹Includes Springettsbury Service Area

²Included in York Service Area

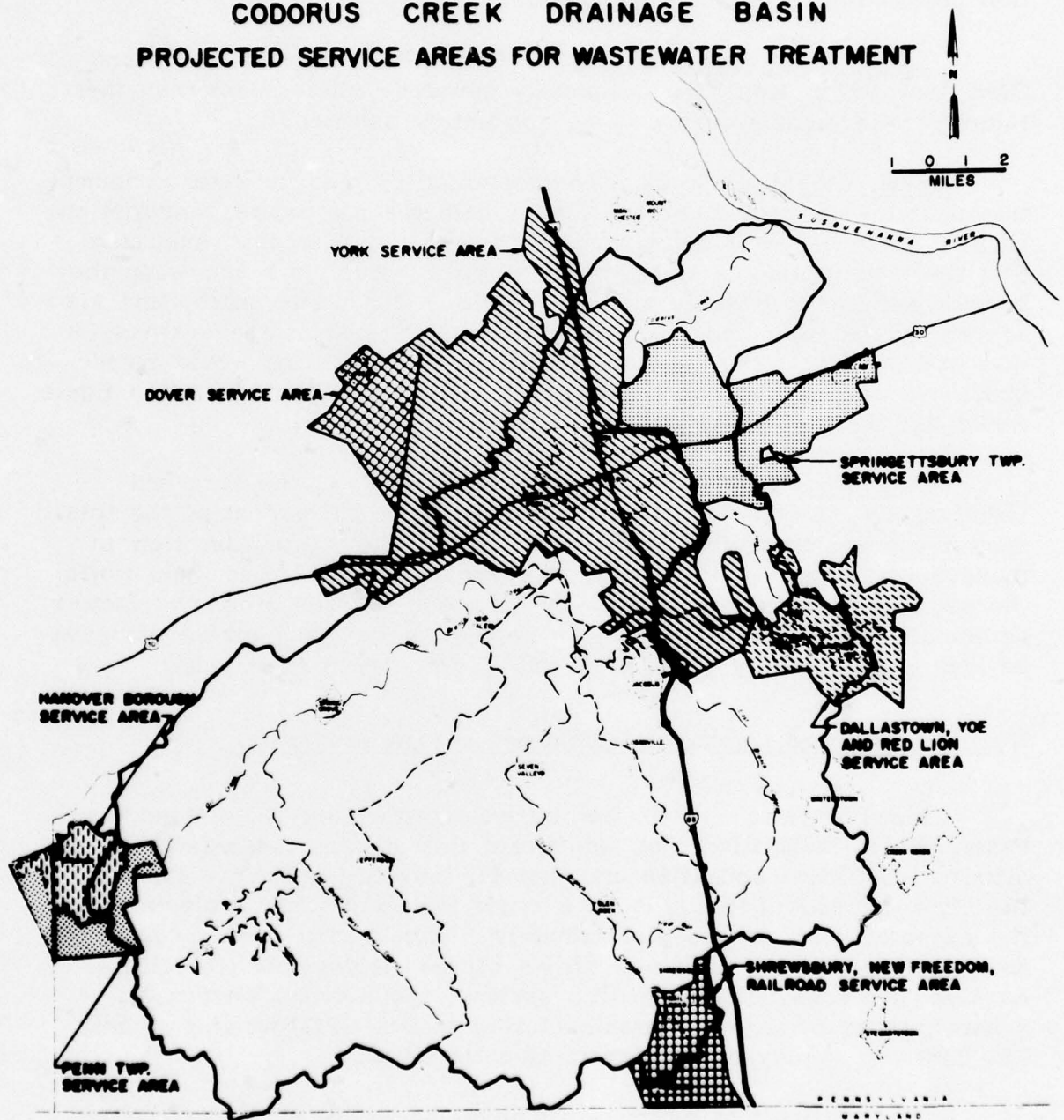
³Greatly Expanded Service Area

EXHIBIT II-10



YORK URBAN AREA DOMESTIC
WATER CONSUMPTION TRENDS

**CODORUS CREEK DRAINAGE BASIN
PROJECTED SERVICE AREAS FOR WASTEWATER TREATMENT**



assumed that the domestic water consumption would increase to 80 gpcd in 1980 due to increases in water consumption in sewerred areas. It was also assumed that from 1980-2020, the domestic per capita wastewater generation trend would follow York domestic water consumption growth rate of 8 gpcd per decade.

Spring Grove and Glen Rock - Presently the Spring Grove and Glen Rock Urban Areas are completely sewerred. It was assumed that future growth areas would also be completely sewerred.

Semi-Urbanized Areas - An inspection of present water consumption data in the semi-urbanized areas indicates per capita consumption figures which are well below that of the urbanized areas. Assuming that the consumption of water in these areas would increase when they become sewerred but would still be less than the urban areas, and also assuming that there are no industrial developments in these areas, it was estimated that the per capita wastewater generation would be 80 gpcd. It was assumed that this per capita wastewater generation figure would not increase from 1980 to 2020.

Summary - As can be seen from Exhibit II-9, the York and Springettsbury Service Areas will generate about 70 percent of the total domestic wastewater flow in the year 2000. The wastewater flow in these Service Areas will increase 213 percent from 1970 to 2000 while the population is increasing by only 79 percent. The other two factors determining wastewater increases - per capita flow and extent of sewerred area - increase by 21 percent and 45 percent, respectively.

Manufacturing and Commercial Wastewater Flow Projections

Manufacturing and commercial wastewater flow projections are based on the realization that significant flow differences exist between different industrial activities and that all industries will not experience the same growth. For instance, a major impact on flow projections is the expected shift from a predominately manufacturing economy to a predominately service economy as shown by the employment projections. As will be discussed later in this section, the average wastewater generation per employee in manufacturing is 292 GPD while it is only 122 GPD per employee in commercial enterprises.

It is difficult to estimate the level of output of each industry over the next 50 years, and the problem is compounded by the many process modifications available to each industry to reduce or recycle its water stream. To approximate future manufacturing and commercial wastewater flows, it has been assumed that flows would be proportional

to employment on an industry by industry basis - wastewater flow per employee for each industry remains constant. This balances the two factors that: 1) output per employee will probably increase; while 2) wastewater discharged per unit output will probably decrease.

Presently, all manufacturing and commercial wastewater does not go to the municipal sewage treatment plants--for instance, in the York Urban Node approximately 25 percent of this flow is discharged directly to the Codorus Creek or its tributaries. Recognizing that in the future all wastes will be required to be treated, projections in this section include the total manufacturing and commercial wastewater flow. The following paragraphs will describe in more detail the flow projection procedures used for each Urban Node--first, the Greater York Urban Node; and then the smaller Urban Nodes.

York Urban Node - The 1969 Industrial Wastewater Inventory of the York Sewer Study listed waste discharges by industry. These were grouped into 20 manufacturing classifications and one commercial classification, and the percentage of total flow in each classification was computed as shown in Exhibit II-12. A further breakdown was made for the York Urban Node between the York Service Area and the Springettsbury Service Area. The 1969 flows were updated to 1970 by applying the above percentages, to the total 1970 manufacturing-commercial flow of the York Urban Node of 10.7 MGD (See Part I). The infiltration flow shown on Exhibit II-12 is that attributable to manufacturing-commercial flows.

Employment increases for the secondary (manufacturing) and tertiary (commercial) sectors were presented on page II-12 and are the basis for the flow projections on Exhibit II-12. A separate breakdown of sector employment for the York and Springettsbury Service Areas was made. An additional breakdown of employment increases was made for each of the 20 manufacturing classifications based on an estimate of the relative growth of each classification. For instance, the overall employment growth in the manufacturing sector between 1970 and 1980 is estimated to be 15 percent for the York Service Area. The individual classification growth rates were adjusted around that average and ranged from 5 percent to 22 percent. Commercial flows were not broken down into subclassifications because the total flow is much less than manufacturing and because data was not available to facilitate subclassification. Similar projections were made for the years 2000 and 2020.

Exhibit II-12 MANUFACTURING AND COMMERCIAL WASTEWATER PROJECTIONS FOR THE YORK URBAN NODE (York and Springettsbury Service Areas)

Classification	Wastewater Flow of 1990 Total		Wastewater Flow MGD 1970		Growth Projection 1970-1990		Wastewater Flow MGD 1990		Growth Projection 1970-2020		Wastewater Flow MGD 2020	
	York	Springet.	York	Springet.	York	Springet.	York	Springet.	York	Springet.	York	Springet.
MANUFACTURING (Secondary)												
1. Ordnance & Accessory	.5	17.5	.05	1.71	5	5	.05	1.80	10	20	.06	.06
2. Food & Kindred	5.5	.1	.54	.01	22	35	.66	.01	55	70	.84	.84
3. Tobacco Products	.2	-	.02	-	5	-	.02	-	10	-	.02	.02
4. Textile Products	.9	-	.09	-	20	-	.11	-	45	-	.13	.13
5. Apparel & Related	.2	-	.02	-	10	-	.02	-	30	-	.03	.03
6. Lumber & Wood	.3	-	.03	-	12	-	.03	-	35	-	.04	.04
7. Furniture & Fixtures	2.2	.7	.22	.07	20	30	.26	.09	50	70	.33	.33
8. Paper & Allied	11.7	.1	1.15	.01	20	30	1.39	.02	50	70	1.73	.03
9. Printing, Publishing	.2	.2	.02	.02	22	35	.03	.03	55	55	.03	.03
10. Chemical & Allied	.6	-	.06	-	10	-	.07	-	30	-	.08	.08
11. Petrol & Coal Prod.	-	-	-	-	-	-	-	-	-	-	-	-
12. Rubber & Plastics	-	-	-	-	-	-	-	-	-	-	-	-
13. Leather	-	-	-	-	-	-	-	-	-	-	-	-
14. Stone, Clay, Glass	10.6	-	1.04	-	16	-	1.22	-	40	-	1.46	1.46
15. Primary Metal	.7	-	.07	-	15	-	.08	-	40	-	.10	.10
16. Fabricated Metal	12.3	1.9	1.21	.19	17	25	1.43	.24	40	60	1.70	1.70
17. Machinery except Electrical	6.4	3.7	.63	.36	20	27	.76	.46	45	65	.92	.92
18. Electrical Machinery, Equipment	4.0	.8	.39	.08	20	27	.48	.10	55	70	.59	.59
19. Transportation Equipment	.2	-	.02	-	16	-	.02	-	45	-	.03	.03
20. Instruments & Related	.5	-	.05	-	15	-	.06	-	40	-	.07	.07
MANUFACTURING-Subtotal	-	-	5.61	2.45	-	-	6.69	2.77	-	-	8.16	8.16
COMMERCIAL/Tertiary	15.1	2.9	1.48	.28	32	43	1.96	.40	124	156	3.32	4.76
INFILTRATION	-	-	-	.90	-	-	.90	.30	-	-	1.20	1.30
TOTAL	100.0%	10.72	9.55	3.45			12.66	4.40			14.22	6.21

1. Infiltration attributable to Manufacturing-Commercial flows. Infiltration attributable to domestic flows is included in domestic flow projections.

Other Urban Nodes - Much less information was available on the manufacturing and commercial wastewater generation for the other urban nodes in the Codorus Creek study area. The manufacturing-commercial flows in 1970 treated in municipal facilities have been estimated as described above for the York Urban Node and were added to any direct discharges in the service area to obtain the total manufacturing-commercial wastewater flow. These flows are, in most cases, a relatively smaller percentage of the total flow than in York and Springettsbury, which is consistent with the lack of a manufacturing employment base in these areas.

The stated objective of the York County Planning Commission is to make each of the urban nodes more economically self-sufficient. The extent to which this will occur is uncertain. It is therefore, impossible to predict the exact mix of industrial activities that will develop in any area. Industrial and commercial flow projections for these areas were based on wastewater generation estimates for an average mix of projected future employment activities.

Between 1980 and 2020 in the Codorus Creek study area outside of the Greater York Node, about 30% of the increase in total employment is projected to be in the manufacturing (secondary) sector, 63% in the commercial (tertiary) sector, and 7% in the agricultural and mining (primary) sector. The simplifying assumption was then made that 1/3 of the new jobs created in the urban nodes would be manufacturing and 2/3 would be commercial. From the data for York and Springettsbury for 1969, it is found that manufacturing generates 292 GPD of wastewater per employee, and commercial enterprises generate 122 GPD per employee. Thus, the average wastewater flow per new employee in the areas other than York and Springettsbury is $\frac{1}{3} (292) + \frac{2}{3} (122) = 178$ GPD. The number of new employees was obtained from the population projections using a labor force participation rate of 39.0% for 1970, 38.5% for 1980, 38.0% for 2000 and 37.8% for 2020. The manufacturing-commercial wastewater flows projected by this method were added to 1970 flows and are shown in Exhibit II-13.

For the semi-urbanized area it was assumed that there would be no significant industrial or commercial enterprises.

The projected wastewater flows of the P. H. Glatfelter Company of 23 MGD in 1980 and 28 MGD in 2000 and 2020 is discussed in the section on water supply.

Exhibit II-13
MANUFACTURING-COMMERCIAL WASTEWATER PROJECTIONS

Service Area	Year	Population in Area	Total Employment in Area	Manu.- Comm. Wastewtr. Increase since 1970 (MGD)	Manu.- Comm. Waste- water Flow (MGD)
<u>Hanover-Penn Township Urban Node</u>					
Penn Twp. Service Area	1970	8,000**	3,100	--	.5
	1980	9,000	3,500	.07	.57
	2000	13,000	4,900	.32	.82
	2020	18,000	6,800	.66	1.16
Hanover Borough Service Area	1970	21,800	8,500	--	.3
	1980	23,500	9,100	.11	.41
	2000	27,000	10,300	.32	.62
	2020	32,000	12,100	.64	.94
<u>Red Lion-Dallastown-Yoe Urban Node</u>					
Red Lion Service Area	1970	10,000	3,900	--	.18
	1980	15,500	6,000	.37	.55
	2000	20,400	7,800	.70	.88
	2020	30,000	11,300	1.32	1.50
<u>Shrewsbury-New Freedom-Railroad Urban Node</u>					
New Freedom Service Area	1970	3,500	1,400	--	.25
	1980	6,500	2,500	.16	.41
	2000	12,000	4,600	.57	.82
	2020	20,000	7,600	1.10	1.35

Exhibit II-13
(Cont.)

Service Area	Year	Population in Area	Total Employment in Area	Manu.- Comm. Wastewtr. Increase since 1970 (MGD)	Manu.- Comm. Waste- water Flow (MGD)
<u>Spring Grove Urban Node</u>					
Spring Grove Service Area	1970	1,700	700	--	0
	1980	3,100	1,200	.09	.09
	2000	3,400	1,300	.11	.11
	2020	7,500	2,800	.37	.37
<u>Glen Rock Urban Node</u>					
	1970	1,600	600	--	0
	1980	2,100	800	.04	.04
	2000	3,000	1,100	.09	.09
	2020	7,500	2,800	.39	.39
<u>Dover Urban Node</u>					
Dover Service Area	1970	10,100**	3,900	--	.03
	1980	12,400**	4,800	.16	.19
	2000	19,300**	7,300	.61	.64
	2020	28,000	10,600	1.19	1.22

** Population includes persons outside service area.

Summary of Projections

Domestic and manufacturing-commercial wastewater flow projections are summarized on Exhibit II-14. Excluding the Glatfelter Company flows, a significant shift will occur in the Basin from the present mix of 50% domestic and 50% manufacturing-commercial to about 70% domestic and 30% manufacturing-commercial by the year 2000. This is accounted for, to a large extent, by the following three factors: 1) 100% of the residential areas are projected to be sewered; 2) manufacturing plants will attempt to minimize waste discharges; and 3) a shift is projected from heavy water using manufacturing to lower usage commercial establishments.

Total wastewater flows will more than double by 2000. The general distribution pattern will remain fairly consistent with about one-half of the total flow generated in the York Urban Node, about one-third generated by the Glatfelter Company, and the remainder by the smaller Urban Nodes.

FUTURE WATER SUPPLY DEMAND ON THE SYSTEM

Domestic and Manufacturing-Commercial Uses

Since the major growth areas in the Codorus Basin will be centered around the urban nodes, it follows that these areas will have the greatest impact on future water demands. Therefore, projections for future water demands, presented in Exhibit II-15, were prepared for the major supply systems servicing these urban nodes. The rural and semi-urban areas were not studied in relation to their future water demands because the growth projected for these areas was quite small and also due to the fact that the present groundwater or surface water resource seems adequate to meet the future water needs of these areas.

The long-term total consumption trend was determined utilizing the least squares regression analysis on the York Water Company data since 1940 and is shown on Exhibit II-16. It should be noted that in the 1960 to 1970 decade, the York Area has experienced a relatively large increase in water consumption due in a large part to the manufacturing-commercial sector. However, it is felt that in the future, the greater emphasis on stream water quality and hence wastewater treatment will encourage industrial concerns to increase their conservation of water through recycling techniques, etc. Thus, it was felt that the short-term water consumption growth rate as experienced in the past decade by the York Urban Node should not be used directly to project future long-term water demands. For projecting the future long-term

Exhibit II-14
SUMMARY
PRESENT & PROJECTED WASTEWATER FLOWS

SERVICE AREA	1970 Avg. Daily Wastewater Flow* (MGD)			1980 Avg. Daily Wastewater Flow (MGD)			2000 Avg. Daily Wastewater Flow (MGD)		
	Domestic	Manufacturing and Commercial	Total	Domestic	Manufacturing and Commercial	Total	Domestic	Manufacturing and Commercial	Total
<u>York Urban Nucle</u>									
York Service Area	9.0	10.7	19.7	12.7	9.6	22.3	22.8	12.7	35.5
Springettsbury Service Area	-	-	-	2.9	3.5	6.4	5.4	4.4	9.8
Diner Service Area	0.12	0.03	0.15	0.9	0.2	1.1	2.2	0.6	2.8
<u>Hanover-Rose Township Urban Nucle</u>									
Rose Top Service Area	0.5	0.5	1.0	0.8	0.6	1.4	1.4	0.8	2.2
Hanover Borough Service Area	1.7	0.3	2.0	2.3	0.4	2.7	3.3	0.6	3.9
<u>Red Lion-Hallastown-Vue Urban Nucle</u>									
Red Lion-Hallastown-Vue Urban Nucle	0.25	0.18	0.43	1.0	0.6	1.6	1.8	0.9	2.7
<u>Shrewsbury-New Freedom Railroad Urban Nucle</u>									
Shrewsbury-New Freedom Railroad Urban Nucle	0	0.25	0.25	0.5	0.4	0.9	1.1	0.8	1.9
<u>Spring Grove Urban Nucle</u>									
Spring Grove Urban Nucle	0.1	17.2	17.3	0.2	23.0	23.2	0.3	28.0	28.3
<u>Glenn Rock Urban Nucle</u>									
Glenn Rock Urban Nucle	0.2	-	0.2	0.2	0.04	0.24	0.4	0.1	0.5
<u>Semi-Urbanized Area</u>									
Jacobus	-	-	-	0.16	-	0.16	0.24	-	0.24
Lepanville	-	-	-	0.10	-	0.10	0.17	-	0.17
New Salem	-	-	-	0.12	-	0.12	0.13	-	0.13
Seven Valleys	-	-	-	0.06	-	0.06	0.07	-	0.07
Jefferson	-	-	-	0.04	-	0.04	0.04	-	0.04
Winterslows	-	-	-	0.03	-	0.03	0.03	-	0.03
TOTAL	11.9	29.1	41.0	22.0	38.3	60.3	39.4	48.9	88.3
							59.8	58.8	118.6

* 1970 wastewater flows include present average annual sewage treatment plant flows together with direct industrial discharges.

Exhibit II-15

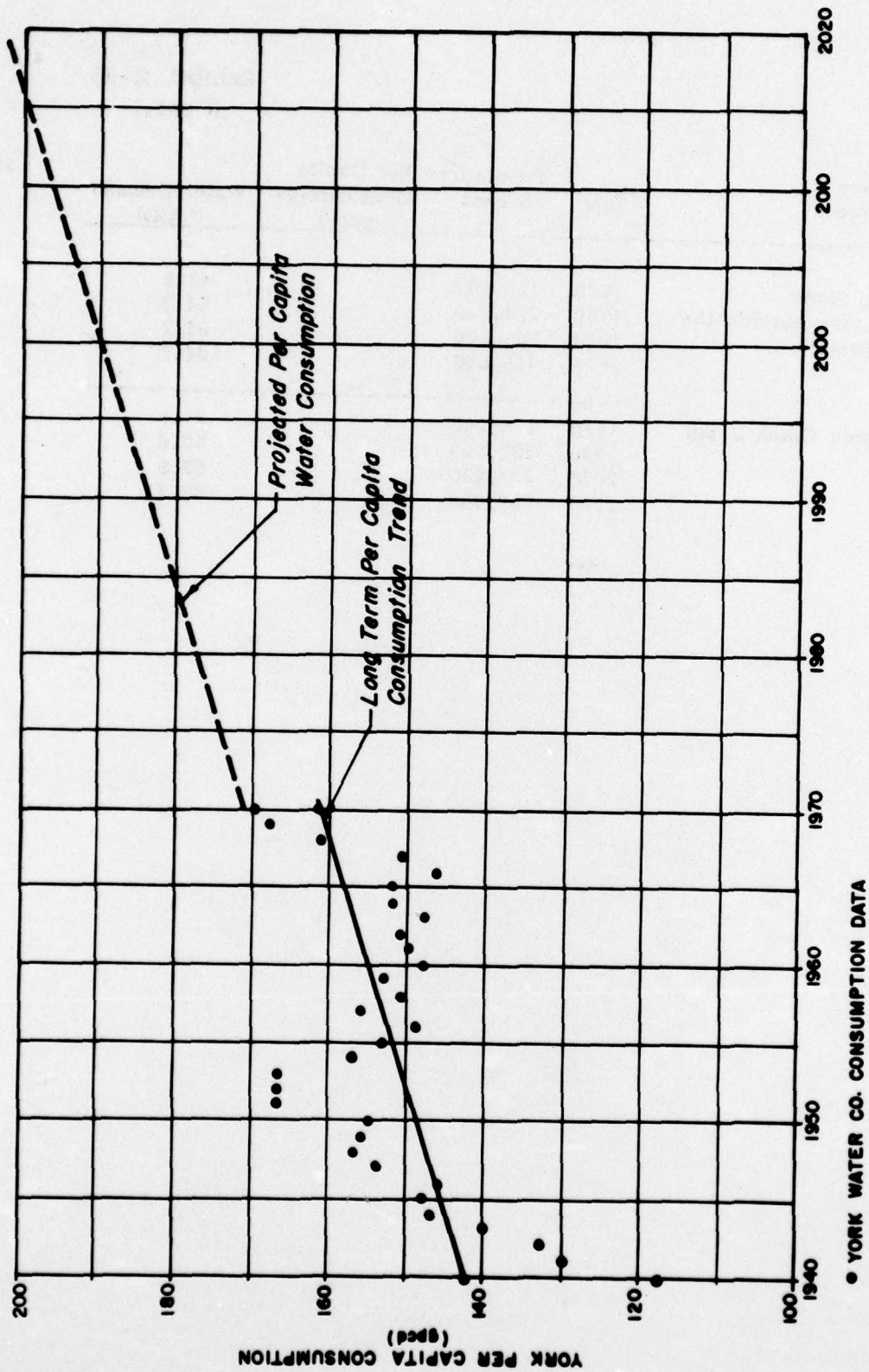
PROJECTED WATER DEMANDS FOR MAJOR SUPPLY SYSTEMS SERVICING THE URBAN NODES

Supply Source & Service Area	Year	Population Served	Per Capita Consumption (gpcd)	Water Demand (MGD)
<u>East & South Branch Codorus Creek Sub-basin</u>				
York Urban Node (excluding Dover Service Area)	1970	117,900	170	20.0
	1980	145,800	177	25.8
	2000	209,000	190	39.7
	2020	272,000	203	55.2
Shrewsbury-New Freedom- Railroad Urban Node	1970	3,700	105	0.39
	1980	6,500	113	0.7
	2000	12,000	129	1.5
	2020	20,000	145	2.9
Glen Rock Urban Node	1970	1,600	82	0.13
	1980	2,100	90	0.2
	2000	3,000	106	0.3
	2020	7,500	122	0.9
<u>West Branch Creek Sub-basin</u>				
Spring Grove Urban Node	1970	2,000	100	0.2
	1980	3,100	108	0.3
	2000	3,400	124	0.4
	2020	7,500	140	1.1
P.H. Glatfelter Co.	1970	-	-	17.2
	1980	-	-	23.0
	2000	-	-	28.0
	2020	-	-	28.0
<u>Cabin Creek Sub-basin</u>				
Dallastown-Yoe-Red Lion Urban Node	1970	11,400*	105	1.2
	1980	15,500	113	1.8
	2000	20,400	129	2.7
	2020	30,000	145	4.4
<u>Conewago Creek Sub-basin</u>				
Dover Service Area	1970	1,200	125	0.15
	1980	9,300	133	1.2
	2000	18,000	149	2.7
	2020	28,000	165	4.6
Hanover-Penn Township Urban Node	1970	28,000	111	3.1
	1980	32,500	119	3.9
	2000	40,000	135	5.4
	2020	50,000	151	7.6

*Includes 1,400 in Windsor Township.

**Exhibit II-15
(Cont.)**

Supply Source & Service Area	Year	Population Served	Per Capita Consumption (gpcd)	Water Demand (MGD)
Total Urban Node (includes areas outside the Codus Basin)	1970	163,400		42.5
	1980	214,800		54.3
	2000	305,800		81.2
	2020	415,000		104.7
Total Codorus Creek Basin Only	1970	125,200		37.9
	1980	157,500		50.0
	2000	227,400		69.9
	2020	307,000		88.1



PROJECTED PER CAPITA WATER CONSUMPTION
FOR THE YORK-SPRINGETTSBURY URBAN AREA

water demand on the York system, the 1940 to 1970 consumption trend (slope of the line in Exhibit II-16) was used and translated upward as shown in Exhibit II-16 to coincide with the 1970 water use conditions.

When comparing projected water demands and wastewater generation for the York Area, the wastewater generation is found to be greater. However, 10-15% of these wastewater flows are due to storm and ground-water infiltration. When this is taken into account, the water demand equals projected wastewater flows.

The method used to project York's water needs could not be used for the other urban areas due to the lack of information concerning past consumption data. However, present per capita consumption data is available and was presented in Phase I. Since these areas are less industrialized than York, (excluding Spring Grove) it was felt that changes in per capita water consumption would be accounted for mainly by the domestic sector. It is assumed that the growth rate of domestic water consumption in these urban areas would reflect the same growth rate as experienced by the domestic sector of the York Urban Node (see Exhibit II-10) namely, 8 gpcd per decade. Therefore, the water demands for these areas were projected by multiplying their anticipated population by their per capita water consumption figures which were increased by 8 and 24 gpcd over their 1970 figures for the years 1980 and 2000, respectively. In this analysis, it was assumed that 100% of the population in these urban nodes would be connected to public water supplies.

Water supply projections for the Spring Grove Urban Node could not be made by the previously mentioned method due to the large industrial consumption made by the P. H. Glatfelter Company. A meaningful projection for this area must reflect the future needs of the industry. Private correspondence with the Glatfelter Company has indicated that the 1962 water resources report on the Codorus Creek Basin* presented reasonable water projections for the company. Interpolation of these projections results in a 23 MGD figure for 1980. The total yield of the present Glatfelter reservoir system is 30 MGD. It is expected that, because of increasingly stringent wastewater quality requirements and the associated treatment costs, the Glatfelter Company will attempt to minimize its wastewater flows and in turn its water supply requirements, by recycling and process changes. Therefore, it has been assumed that, although Glatfelter's paper production may increase in the future, its water consumption will not increase above approximately 28 MGD.

*Commonwealth of Pennsylvania, Department of Forest and Water, Report on Water Resources Study of Codorus Creek Basin and Vicinity, by Bourguart, Geil and Associates, Harrisburg, Pennsylvania, June 1962.

Availability of Supplies

Municipal and industrial water supply requirements in the Codorus Basin Study Area have been estimated at 50 MGD for the year 1980 and 69.9 MGD for the year 2000. These future needs compare to a present usage of 37.9 MGD.

The Codorus Basin surface waters have been the principal source of the water supply requirements to date. Extensive storage and diversion programs exist which have developed a major part of the total supply capability of the Basin. These include the two storage lakes and diversion works of the York Water Company which regulate the South and East Branches of the Creek and the three storage impoundments on the West Branch which regulate the flows for the supply needs of the P. H. Glatfelter Company.

The total available dependable supply capability of these two flow management systems is presently 59.2 MGD based on the following breakdown:

Dependable Yield (MGD)			
	<u>Gross Yield</u>	<u>Min. Required Flow Release</u>	<u>Net Yield</u>
York Water Company impoundments (Lakes Williams, Redmond and South Branch diversion)	33.0	3.8	29.2
West Branch impoundments (Lakes Marburg, Lehman, PaHaGaCo)	32.4	2.4	30.0

As can be seen by referring back to Exhibit II-15, these yields will be sufficient to meet projected demands for the York Water Company service area through 1985. However, a deficiency of 10.5 MGD will exist by the year 2000.

Of the smaller water systems in the Basin study area, the Red Lion and the Hanover-Penn Township systems use surface water and all others use groundwater. All of these smaller systems can meet the projected demands by expansion of their present sources or by development of readily available nearby reservoirs as outlined in the 1962 Bourguart, Geil and Associates report.

Some additional undeveloped water supply potential exists in the Codorus Basin. At the confluence of the South (including the East) and West Branches the average annual flow is approximately 124 MGD (200 cfs). About one-half of this (59.2 MGD) is already developed by the York Water Company and Glatfelter facilities, and it could probably not be reused directly for municipal water supply. The year 2000 deficiency for the York Water Company of 10.5 MGD is only 15 percent of the remaining potential.

Limited availability of additional storage facilities to further regulate the remaining capacity of the Basin is the principal drawback to expansion of in-basin supplies. Virtually all large economical storage reservoir site opportunities have been exhausted. Also, the additional yield of any new facility is substantially reduced by the regulation effect of the present extensive flow management facilities. One major new storage opportunity is the existing Indian Rock Dam. Storage at this dam could develop the remaining capacity of the West Branch, and with a pumping station and diversion pipeline from the South Branch, could also develop the remaining capability of this tributary.

WATER QUALITY MANAGEMENT OBJECTIVES

The bases for the control of waste discharges in a basin are the uses to be protected and enhanced for the waters affected by the discharges. For the Codorus Basin, present waste discharges affect most of Codorus Creek, the Susquehanna River and to some uncertain extent the waters of Cheasapeake Bay.

Under the present federal and state programs for water quality management, the level of treatment performance required of waste discharge sources is determined by the allowable concentration of specific constituents that will not interfere with the pursuance of the uses established for a particular water course.

The Commonwealth of Pennsylvania has developed groups of protected uses for all of the surface waters in Pennsylvania. All of the surface waters of Codorus Creek are designated for the highest uses encompassing game fish, domestic water supply and water contact sports. However, due to natural temperature management limitations, most of the basin is designated for warm water fish. The East Branch and the east fork of the West Branch are the only units designated for cold water fish.

Water Quality Stream Standards

The water quality criteria for streams adopted by the Water Quality Agency of the Commonwealth of Pennsylvania are summarized in Exhibit II-17. Group A criteria are considered applicable for a cold water or trout fishery while Group B criteria are considered adequate to sustain a facultative or warm water fishery.

There are also a number of specific criteria not in the standard groups. These include: turbidity, odor, cyanide, sulfate, chloride, phosphates, color, various metals, etc. Of these, only the color criteria has been established for Codorus Creek as a result of the color problem produced by the P. H. Glatfelter paper mill.

Although phosphorus water quality criteria have not been established for the Codorus Basin itself, a program of 80 percent reduction of total phosphorus discharge is in effect for all plants within the Basin. This requirement is applicable as part of the interstate pollution abatement plan for the Susquehanna River which calls for the reduction of phosphorus loadings within the Basin.

Existing Action

A pollution abatement implementation plan has been established by the Commonwealth of Pennsylvania for the surface water of the lower Susquehanna, covering York and Adams Counties. This plan calls for, as a minimum, the equivalent of secondary biological treatment. However, for discharges to the Codorus Creek Basin higher levels of biological waste treatment, dissolved oxygen enhancement and phosphorus reduction have been stipulated to meet stream quality criteria. A special program for reduction of color emanating from the discharge of the P. H. Glatfelter Company has also been stipulated.

Exhibit II-18 lists the stipulated discharge conditions and timetable for the plants located in the study area. Improvements are required at all plants except the Dover Borough, Glen Rock and the recently completed Springettsbury Township plants. Two new plants (the New Freedom/Railroad and Dover Township facilities) which are presently in the final design stage have not been designed with phosphorus removal facilities incorporated.

EXHIBIT II- 17

WATER QUALITY CRITERIA

Water Characteristics	Criteria Groups	
	Group A	Group B
1. pH	a1 6.0 to 8.5	a1 6.0 to 8.5
2. Dissolved Oxygen	b1 Minimum daily average 6.0 mg/L; no value less than 5.0 mg/L.	b2 Minimum daily average 5.0 mg/L; no value less than 4.0 mg/L.
3. Total Iron	c1 Not to exceed 1.5 mg/L	c1 Not to exceed 1.5 mg/L
4. Temperature	d1 Not to be increased more than 5° above natural temperatures or to be increased above 58° F.	d2 Temperature not to ex- ceed 5° F. rise above ambient temperature or a maximum of 87° F. which- ever is less; not to be changed by more than 2° F. during any one hour period.
5. Dissolved Solids	e Not to exceed 500 mg/L as a monthly average value; not to exceed 750 mg/L at any time.	e Not to exceed 500 mg/L as a monthly average value; not to exceed 750 mg/L at any time.
6. Bacteria (Coliforms)	f For period 5/15 to 9/15, coliforms not to exceed 1000/100 ml. For period 9/16 to 5/14, coliforms not to exceed 5000/100 ml.	f For period 5/15 to 9/15, coliforms not to exceed 1000/100 ml. For period 9/16 to 5/14, coliforms not to exceed 5000/100 ml.

Exhibit II-18
DISCHARGE CONDITIONS AND TIMETABLE

Plant	Conditions ¹	Order Issued	Compliance Date				
Glen Rock Borough	95% BOD ₅ Removal, 5/1 to 10/31 90% BOD ₅ Removal Remainder of Year	10/2/68	10/2/68				
New Freedom Borough ¹	≤ 15 mg/l BOD ₅ ≥ 6 mg/l D.O.	5/1/69	Upon Start-Up				
Spring Grove Borough	≤ 7 mg/l BOD ₅ , 5/1 to 10/31 ≤ 14 mg/l BOD ₅ , Remainder of Year ≥ 6 mg/l D.O.	8/2/68	6/30/71				
Red Lion Borough	≤ 10 mg/l BOD ₅ , 5/1 to 10/31 ≤ 20 mg/l BOD ₅ , Remainder of Year ≥ 6 mg/l D.O.	8/2/68	6/30/71				
Penn Township	≤ 10 mg/l BOD ₅ , 5/1 to 10/31 ≤ 20 mg/l BOD ₅ , Remainder of Year ≥ 6 mg/l D.O.	8/2/68	6/1/71				
City of York	≤ 7 mg/l BOD ₅ , 5/1 to 10/31 ≤ 14 mg/l BOD ₅ , Remainder of Year ≥ 6 mg/l D.O.	8/2/68	6/30/72				
Dover Borough	95% BOD ₅ Removal, 5/1 to 10/31 90% BOD ₅ Removal Remainder of Year	8/2/68					
Dover Township	95% BOD ₅ Removal, 5/1 to 10/31 90% BOD ₅ Removal Remainder of Year 6 mg/l D.O.						
Hanover	< 15 mg/l Total BOD ² < 2 mg/l P ≥ 6 mg/l D.O. < 25 mg/l S.S.		1/31/75				
P. H. Glatfelter	≤ 7 mg/l BOD ₅ ≥ 6 mg/l D.O.	8/7/68					
<table> <tr> <td>Color in Stream</td> <td>50 Color Units</td> <td>8/7/68</td> <td>6/30/77</td> </tr> </table>				Color in Stream	50 Color Units	8/7/68	6/30/77
Color in Stream	50 Color Units	8/7/68	6/30/77				

Applicable to All Plants: Disinfection to 200/100 ml Fecal Coliform as a Geometric Average Not Greater than 10% of Samples Tested.

Total Phosphorus Reduction of at Least 80% at Time of Major Plant Improvement

¹ Plant in Design Stage.

² Total BOD computed as $1.5 \times \text{BOD}_5 + 4.5 \times \text{NH}_3$ Concentration.

General Effect of Present Implementation Plan

The long-range effect of the present program for reduction of waste discharges, both industrial and municipal, is summarized by Exhibit II-19 in terms of the total amounts of wastes from the study area discharged to the surface waters. The 1970 calculations apply to present performance of each treatment plant whatever it may be. The 1980 and 2000 calculations refer to conditions of discharge which meet the new Pennsylvania discharge criteria.

Changes in other critical considerations also will occur between the 1970 and 1980 load conditions. Both the York Urban Node and the P. H. Glatfelter Paper Company will increase their flows by 50% over the 1970 levels. The York STP is shown as being upgraded markedly from its 1970 performance of typically 50 mg/l BOD₅ and 100 mg/l suspended solids.

The overall result of the new discharge conditions in 1980 are significant with BOD₅ and phosphorus both reduced by 60% and suspended solids reduced by 80%. Nitrogen as ammonia or nitrate is not reduced in concentration by the change in discharge conditions. However, by the year 2000, total phosphorus is shown as returning to a level approximately half the present amount and total nitrogen will increase by 230 percent. Additional amounts of the above and other constituents will be contributed by rural land and agricultural runoff and by urban storm drainage.

Discussion of Nutrient Reduction Relationships

Although stipulations are in effect for the reduction of phosphorus discharges from treatment plants located in the Codorus Basin, specific criteria for the control of nutrient conditions within the Basin itself have not been established. However, Pennsylvania has developed in certain other basins phosphorus concentration criteria that restrict allowable total soluble phosphate (as PO₄) to from 0.1 to 0.4 mg/l depending on the nature of the water body to be protected.

The following discussion attempts to bring into focus the water quality significance of phosphorus, ammonia and nitrogen, and the potential quantified levels of discharge management presently indicated to be necessary. It should be noted that ammonia removal is presently incorporated in the pollution abatement programs of a number of states (Illinois, Wisconsin).

EXHIBIT II-19

PROJECTED CODORUS BASIN WASTEWATER CONSTITUENT LOADINGS UNDER PRESENT STATE TREATMENT PERFORMANCE CRITERIA

Service Area	Wastewater Loadings (lbs/day)						2000 ²					
	1970 ¹			1980 ²			1980 ²			2000 ²		
	BOD ₅	Sus. Solids	Total N	Total P	BOD ₅	Sus. Solids	Total N	Total P	BOD ₅	Sus. Solids	Total N	Total P
CODORUS BASIN												
Greater York	7,170	13,390	2,010	1,160	2,515	2,515	3,360	385	3,970	3,970	5,300	505
Penn Twp.	325	365	3	35	175	175	3	10	275	275	5	15
Dallestown-Yoe Red Lion	20	20	90	35	110	120	270	20	185	200	455	35
Glen Rock	40	65	50	20	50	75	60	3	100	130	125	8
Spring Grove	1,760	7,300	1,880	35	1,360	1,360	2,535	45	1,660	1,660	3,100	50
New Freedom-Shrewsbury Railroad	5	10	-	3	110	110	150	15	230	230	315	20
Codorus Basin Total	9,320	21,150	4,033	1,288	4,320	4,355	6,378	478	6,420	6,465	9,300	733
CONEWAGO CREEK												
Fianover City	500	585	330	167	350	350	470	47	490	490	650	65
Dover Borough	38	44	25	12	110	110	150	15	350	350	470	47
Conewago Cr. Total	538	629	355	179	460	460	620	62	840	840	1,120	112

¹ 1970 wastewater loadings include municipal and direct industrial discharges into the Codorus Basin as shown in Exhibits I-10 and I-11.

² In place improvements of existing treatment plants were assumed to meet Commonwealth treatment performance criteria for BOD₅ as shown in Exhibit II-18. In order to meet the BOD₅ concentration it was assumed that the suspended solids would be the same. Also by 1980 it was assumed that 80% phosphorus removal would have to be achieved.

Phosphorus - Of the three principle nutrients required for algal metabolism in aquatic environments, i.e. carbon, nitrogen and phosphorus, phosphorus can generally be shown to be the nutrient that limits algal growth when the eutrophication rate is reduced to the background level in equilibrium with the natural dissolution and decay characteristics of a watershed region. Carbon cannot limit because of the background concentration of dissolved carbon dioxide, bicarbonates and carbonates. Nitrogen cannot limit because of the capability of certain species of blue-green algae to fix nitrogen directly from the air. Sawyer¹ in 1947 was the first investigator to report widely a threshold concentration for phosphorus below which algal growth appeared absent. The threshold concentration was 0.015 mg/l phosphorus. This concentration has been confirmed repeatedly by subsequent investigations and most comprehensively by Mackenthun² in 1965 who reported the limiting phosphorus concentration at 0.01 mg/l phosphorus. The Subcommittee for Fish and Aquatic Life of The National Technical Advisory Committee to the Secretary of the Interior for Water Quality Criteria³ reported the following phosphorus criteria in 1968 as practical guidelines which might not eliminate algal growth but which were within the reach of current technology:

Flowing Streams - 0.1 mg/l phosphorus

Streams Entering Impoundments - 0.05 mg/l phosphorus

Nitrogen - Of the three principle nutrients required for algal metabolism in estuarine or near marine environments, i.e. carbon, nitrogen, and phosphorus, it appears that nitrogen is the nutrient that generally is the limiting nutrient for growth of algae at equilibrium background eutrophication rates. The background soluble carbon concentration is once again relatively high because of bicarbonates, etc. The background soluble phosphorus estuarine concentration is somewhat greater than in the purely fresh water or aquatic environment. The estuarine soluble nitrogen concentration by all experimental evidence is diminished and appears to be growth limiting either because of the character of the dissolved inorganics in the nearby marine environment or because of a estuarine retardation of growth of nitrogen-fixing species of blue-green algae. A 1970

¹Sawyer, C. N., "Fertilization of Lakes by Agricultural and Urban Drainage" J. New England Water Works Assoc., 61, 109-127 (1947).

²Mackenthun, K.M., "Nitrogen and Phosphorus in Water", U.S. HEW, PHS, 111 pages (1965).

³National Technical Advisory Committee to the Secretary of Interior, "Water Quality Criteria," FWPCA, 234 pages (1968).

personal communication from Jaworski¹, Chief of the Engineering Section, Chesapeake Technical Support Laboratory, Middle Atlantic Region, FWQA cites nitrogen as the limiting nutrient in the Potomac estuary and in the James River estuary. Brehmer² also has recently reported data on three lower Chesapeake Bay River estuaries that suggests nitrogen is the controlling nutrient in those river reaches where eutrophication is a problem. Growth limiting estuarine nitrogen criteria have not as yet been evolved. Mackenthun³ reports that 0.30 mg/l inorganic nitrogen limited algal growth in a strictly fresh water or aquatic environment.

General - The long range objective for eutrophication control is the achievement of water quality that is in equilibrium with the geology, dissolution and natural decay of a watershed region. For example, if the equilibrium surface fresh water concentration of phosphorus is 0.02 mg/l while the actual surface fresh water phosphorus concentration is 1.0 mg/l, the actual eutrophication rate or algal growth potential is 50 times the equilibrium eutrophication rate, assuming phosphorus is also the eutrophication controlling nutrient at the actual 1.0 mg/l concentration. Furthermore, the sources of controlling nutrient must include the contribution from the resolubilization of decaying algal debris which constitutes an ever accumulating source of nutrient. Aerobic algal decomposition studies recently reported by Jewell and McCarty⁴ suggests that an average of sixty percent of an algal mass will decompose aerobically in one years time. Thus, decaying filamentous algae distributed on a substrate in a stream-bed can provide a major and renewable source of resolubilized nutrient for future downstream algal growth. The more refractory portion of the decaying algal mass remains as unsightly organic debris or turbidity and continues to decay at a much reduced rate.

Ammonia Toxicity - The aquatic life toxic threshold concentration of ammonia in water is interrelated with the system pH and dissolved oxygen concentration. The National Technical Advisory Committee⁵ rec-

¹Jaworski, N., Personal Communication, Volume I-Advanced Waste Treatment and Water Reuse Symposium, Chicago, Pages 1-5 to 1-6, EPA (1971).

²Brehmer, M. L., "Nutrient Dynamics in Three Coastal Plain Estuaries", Water Pollution Control Federation Conference, San Francisco (1971).

³Ibid, page II-37.

⁴Jewell, W.J. and P.L. McCarty, "Aerobic Decomposition of Algae", Environmental Science and Tech., 5, 1023-1031 (1971)

⁵Ibid, page II-37.

ommends a maximum ammonia concentration of 1.5 mg/l at a pH of 8 or above and less than 2.5 mg/l in the pH range of 7. Lee¹, in a personal communication, indicated that evidence from bioassay testing was available that provided the basis for reducing threshold ammonia toxicity concentrations in aquatic environments by a factor of 10 times and that such revisions were being considered for the revised "Water Quality Criteria" report that is currently underway by the National Technical Advisory Committee.

Necessary Effluent Criteria for Basin

Further removal of nitrogen and phosphorus is necessary to obtain water quality conditions for Codorus Creek satisfactory for the multiple water use objectives for which it is to be protected. In view of existing conditions, future projections and the water quality requirements, together with a background of available technology, the appropriate nitrogen reduction should be a nominal 90% or greater and the appropriate total phosphorus reduction should be at the level of 95 to 98 percent. The resulting effluent criteria for treatment plants would be typically 0.2 to 0.4 mg/l phosphorus and 1 to 2 mg/l nitrogen. These are performances that can be achieved by a variety of available technologies.

The only significant water quality parameter not controlled by this methodology is total dissolved solids. The problem of total dissolved solids can be limited to the West Branch below Spring Grove and the Main Stem through York. The only restriction imposed on use of these waters would be their exclusion from use as a public water supply. This is based on the U.S. Public Health Service recommended drinking water limit of 250 mg/l for dissolved solids. All other uses would not be impaired.

¹Lee, G. F., Personal Communication, Professor of Water Chemistry, University of Wisconsin, Madison, Wisconsin (1971).